MULTIMEDIA UNIVERSITY

STUDENT ID NO

MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 2, 2017/2018

DIM5058 –MATHEMATICAL TECHNIQUES 1

(For DIT students only)

14 MARCH 2018
2.30 p.m - 4.30 p.m
(2 Hours)

INSTRUCTIONS TO STUDENT

1. This question paper consists of **7** pages (**5** pages with **4** questions and **2** pages for appendix)
2. Answer **ALL** questions. All necessary working steps must be shown.
3. Write all your answers in the answer booklet provided.

QUESTION 1 [20 Marks]

(a) Solve the absolute equation, $5|x-1|+2+9x=3(1+3x)$. (5marks)

(b) Find the solution of the rational inequalities, $\frac{2-x}{3x-1}>0$. (4 marks)

(c) Given that $\sqrt{13-9x}=x$, identify the number of real solution(s) by using discriminant. Then, solve the equation if there is/are solution(s). (5 marks)

(d) Find the solution(s) of w if $w^{2/7}+3w^{1/7}-10=30$. (6 marks)

Continued...

QUESTION 2 [30 Marks]

(a) Given that matrix $A = \begin{bmatrix} 10 & -3 & 1 \end{bmatrix}$, $B = \begin{bmatrix} 6 \\ 7 \\ 4 \end{bmatrix}$ and $C = \begin{bmatrix} 3 & 2 & 5 \\ 1 & 0 & 2 \\ 2 & 1 & 0 \end{bmatrix}$, find

(i) $3A - B^T$. (4 marks)

(ii) AC. (4 marks)

(b) Last month, Mr. Azat bought 5 reams of white A4 paper and 3 reams of colour A4 paper from a supermarket which costed him RM69.20. Ms. Lisa also bought 5 reams of white A4 paper and one ream of colour A4 paper from the same supermarket. However, the cost was only RM49.40.

(i) Represent the above information in matrix form, $AX = B$. (1 mark)

(ii) From part b(i), determine the cost of each ream of white A4 paper and colour A4 paper. (6 marks)

(c) A charity body intends to provide scholarships for foundation, diploma or undergraduate students in Multimedia University. The table below shows the number of students who received the scholarship from year 2015 until 2017.

Year	Education Level			Total Amount of Scholarship Allocated per Year (RM)
	Foundation	Diploma	Degree	
2015	2	1	2	101000
2016	3	2	1	96500
2017	0	4	1	104000

Assuming that the scholarship amount provided to Foundation, Diploma and Undergraduate students are x, y and z respectively.

(i) Represent the above information in the form of $AX = B$. (2 marks)

(ii) From part (i), find the value of x, y and z by using **Cramer's Rule**. (13 marks)

Continued...

QUESTION 3 [30 Marks]

(a) Write the first four term of the sequence whose general form is $a_n = \frac{7a_{n-1} - 2}{3^n}$ when $a_1 = 2$ (4 marks)

(b) Find the sum for $\sum_{m=2}^{5} \frac{(2m-3)!}{m^2}$. (5 marks)

(c) A string is cut into 25 portions with lengths that are in arithmetic progression as shown in Figure 1. The length of the 3rd shortest string is 84cm and the length of the longest string is 304cm.

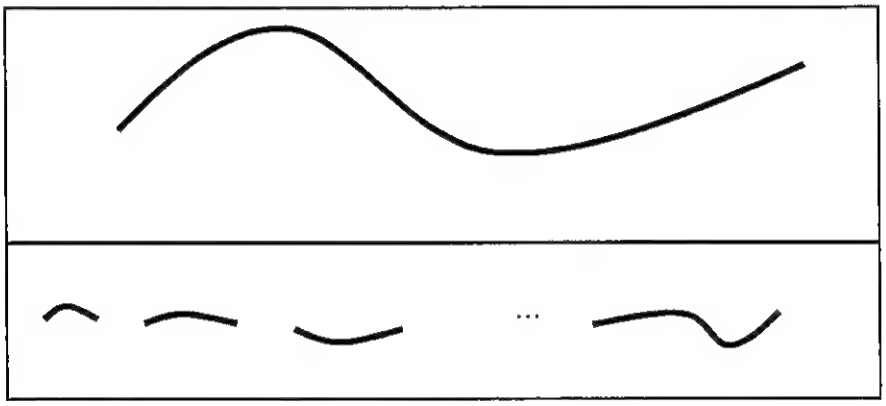

Figure 1

(i) Find the shortest string, a and the common difference, d in these 25 portions. (5 marks)

(ii) Find the length of the string before it was cut. (2 marks)

Continued...

(d) Figure 2 shows the arrangement of cylinders having the same radius, r cm. The height of the first cylinders is 2 cm and the height of each subsequent cylinders increased by 10% of the previous cylinders.

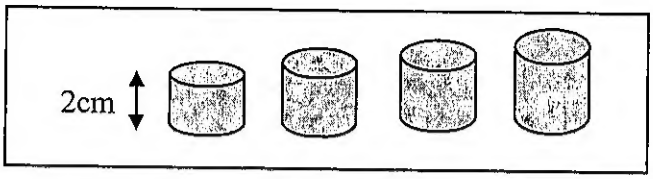

Figure 2

(i) Identify the common ratio, r. (2 marks)

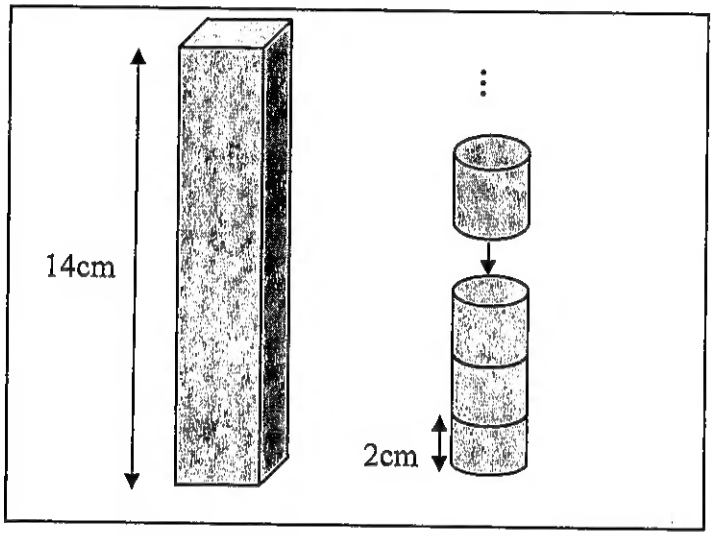

Figure 3

(ii) Calculate the height of the 14^{th} cylinder, in cm. (2 marks)

(iii) If Alvin stacks the 14 cylinders together as shown in Figure 3, identify whether the 14 cylinders will be taller than the block. (3 marks)

(e) Expand $\left(3x + y^2\right)^5$. (7 marks)

Continued...

QUESTION 4 [20 Marks]

(a) Given a function, $y = -x^2 - 2x + 35$,

(i) Determine whether the parabola opens upward or downward. (1 mark)

(ii) Find the vertex of the parabola. (2 marks)

(iii) Find the x-intercept(s). (2 marks)

(iv) Find the y-intercept. (1 mark)

(v) Sketch the parabola and label the necessary points. (4 marks)

(b) Sketch the graph of $y = 1 + 3\sin x$ for $0° \le x \le 360°$. (3 marks)

(c) Given that , $y = \dfrac{x}{2x - 10}$,

(i) Find the horizontal and vertical asymptote if any. (3 marks)

(ii) Sketch the above function in a graph. (4 marks)

End of Page.

APPENDIX

Inequalities:

$\|u\| < a \Rightarrow -a < u < a$	$\|u\| > a \Rightarrow u < -a \quad or \quad u > a$
$\|u\| \leq a \Rightarrow -a \leq u \leq a$	$\|u\| \geq a \Rightarrow u \leq -a \quad or \quad u \geq a$

Completing the square:

$$x^2 + bx + \left(\frac{b}{2}\right)^2 = \left(x + \frac{b}{2}\right)^2$$

Quadratic formula:

If $ax^2 + bx + c = 0$ where $a \neq 0$, then $x = \dfrac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

Standard form of a quadratic function:

$f(x) = a(x - h)^2 + k, \; a \neq 0$

Trigonometric functions:

$y = A \sin(Bx - C)$ or $y = A \cos(Bx - C)$

amplitude $= |A|$, period $= \dfrac{2\pi}{B}$, and phase shift $= \dfrac{C}{B}$.

Determinant of a 2 × 2 matrix	***Determinant of a 3 × 3 matrix***
$\begin{vmatrix} a_1 & b_1 \\ a_2 & b_2 \end{vmatrix} = a_1 b_2 - a_2 b_1$	$\begin{vmatrix} a_1 & b_1 & c_1 \\ a_2 & b_2 & c_2 \\ a_3 & b_3 & c_3 \end{vmatrix} = a_1 \begin{vmatrix} b_2 & c_2 \\ b_3 & c_3 \end{vmatrix} - b_1 \begin{vmatrix} a_2 & c_2 \\ a_3 & c_3 \end{vmatrix} + c_1 \begin{vmatrix} a_2 & b_2 \\ a_3 & b_3 \end{vmatrix}$
Inverse of a 2 × 2 matrix	***Inverse of a 3 × 3 matrix***
If $A = \begin{bmatrix} a & b \\ c & d \end{bmatrix}$ then $A^{-1} = \dfrac{1}{ad - bc}\begin{bmatrix} d & -b \\ -c & a \end{bmatrix}$ where $ad - bc \neq 0$.	$A^{-1} = \dfrac{1}{\|A\|}[c_{ij}]^T$ $A^{-1} = \dfrac{1}{\|A\|}\begin{bmatrix} c_{11} & c_{21} & c_{31} \\ c_{12} & c_{22} & c_{32} \\ c_{13} & c_{23} & c_{33} \end{bmatrix}$ $A^{-1} = \dfrac{1}{\|A\|} adj\, A$ where $[c_{ij}]^T$ is called the adjoint of A (adj A). c_{ij} of the entry $a_{ij} = (-1)^{i+j} M_{ij}$

Cramer's Rule for 2 × 2 matrix	***Cramer's Rule for 3 × 3 matrix***
If $a_1x+b_1y=c_1$ $a_2x+b_2y=c_2$ then $x=\dfrac{\begin{vmatrix}c_1 & b_1\\ c_2 & b_2\end{vmatrix}}{\begin{vmatrix}a_1 & b_1\\ a_2 & b_2\end{vmatrix}}$ and $y=\dfrac{\begin{vmatrix}a_1 & c_1\\ a_2 & c_2\end{vmatrix}}{\begin{vmatrix}a_1 & b_1\\ a_2 & b_2\end{vmatrix}}$ where $\begin{vmatrix}a_1 & b_1\\ a_2 & b_2\end{vmatrix}\neq 0$	$a_1x+b_1y+c_1z=d_1$ If $a_2x+b_2y+c_2z=d_2$ $a_3x+b_3y+c_3z=d_3$ then $x=\dfrac{D_x}{D}, y=\dfrac{D_y}{D}, z=\dfrac{D_z}{D}$ where $D=\begin{vmatrix}a_1 & b_1 & c_1\\ a_2 & b_2 & c_2\\ a_3 & b_3 & c_3\end{vmatrix}$, $D_x=\begin{vmatrix}d_1 & b_1 & c_1\\ d_2 & b_2 & c_2\\ d_3 & b_3 & c_3\end{vmatrix}$, $D_y=\begin{vmatrix}a_1 & d_1 & c_1\\ a_2 & d_2 & c_2\\ a_3 & d_3 & c_3\end{vmatrix}$, $D_z=\begin{vmatrix}a_1 & b_1 & d_1\\ a_2 & b_2 & d_2\\ a_3 & b_3 & d_3\end{vmatrix}$

Arithmetic sequence	***Geometric sequence***
$a_n=a_1+(n-1)d$ $S_n=\dfrac{n}{2}(a_1+a_n)$	$a_n=a_1r^{n-1}, S_n=\dfrac{a_1(1-r^n)}{1-r}$ $S_\infty=\dfrac{a_1}{1-r}, \lvert r\rvert<1$

Binomial Theorem

$$(a+b)^n=\sum_{k=0}^{n}\binom{n}{k}a^{n-k}b^k;\quad n\geq 1$$

The $(r+1)^{st}$ term in the expansion of $(a+b)^n$ is $\binom{n}{r}a^{n-r}b^r$.